Dissecting Policy Designs: An Application of the Institutional Grammar Tool

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Abstract
An enduring challenge for the policy and political sciences is valid and reliable depiction of policy designs. One emerging approach for dissecting policy designs is the application of Elinor Ostrom and Sue Crawford's institutional grammar tool (1995; 2005). The grammar tool offers a method to identify systematically the core elements that comprise policies, including target audiences, expected patterns of behavior, and formal modes of sanctioning for noncompliance. This paper provides three contributions to the study of policy designs by developing and applying the institutional grammar tool. First, we provide revised guidelines for applying the institutional grammar tool to the study of policy design. Second, an additional component to the grammar, called the object, is introduced. Third, we apply the modified grammar tool to four policies that shape Colorado State Aquaculture to demonstrate its effectiveness and utility in uncovering practical and theoretical patterns within policies. The conclusion summarizes the contributions of the paper as well as points to future research and applications of the institutional grammar tool.

Authors' manuscript. Final published version available from: Siddiki, S., Weible, C. M., Basurto, X., & Calanni, J. (2011). Dissecting Policy Designs: An Application of the Institutional Grammar Tool. *Policy Studies Journal, 39*(1), 79–103. http://doi.org/10.1111/j.1541-0072.2010.00397.x

Introduction

One of the enduring challenges in the study of policy designs is creating a systematic way to organize and understand the minute elements that comprise their content. Past typologies and categorizations have been criticized for failing to provide a valid and reliable instrument for inquiry (Lowi, 1972; Wilson, 1979; Eulau, 1969; Froman, 1967). To address a lack of conceptual clarity for understanding the formal institutions that govern social situations, Crawford and Ostrom (1995; 2005) devised an institutional grammar to illustrate the similarities and differences of rules, norms, and strategies as well as to "clarify the distinct influences of each kind of institutional statement [i.e. rules, norms, strategies] on human interaction in diverse action situations" (Crawford and Ostrom 2005, 137).

While the institutional grammar proposed by Crawford and Ostrom (1995; 2005) is useful for its conceptual insight, it does not offer clear guidelines for implementation or empirical application (Basurto et al. 2009; Schluter and Theesfeld forthcoming). Basurto et al., (2009) moved Crawford and Ostrom's grammar closer to realization as a policy design tool. Basurto et al. showcased the promise of the institutional grammar as an analytical tool in the analysis of two policy designs, one for transportation and the other abortion. They also indentified the main unresolved challenges for implementation, which can also help to advance the work of scholars interested in applying the institutional grammar, for example, as a tool for the analysis of legislation (Speer 2008) or the simulation of endogenous rule changes in agent based modeling scenarios (Smajgl et al. 2008).

In this paper we start to respond to some of the most important challenges identified by Basurto et al. (2009) by: (1) Proposing an additional syntactic component to the grammar—the oBject —in order to reduce ambiguity, increase inter-coder reliability, and expand the scope of

possibilities for researchers when conducting nested and configuration analyses relating to the institutional grammar. (2) Revising the guidelines originally proposed by Basurto et al. (2009) for coding the grammar; and (3) Conducting an empirical analysis of Colorado State aquaculture legislation to illustrate some of the new analytical possibilities that emerge through these improvements.

The goal of this paper is to re-introduce the institutional grammar and then to provide a proof of concept in an empirical application. This paper proceeds in two parts. The first part provides an overview of the IAD necessary to understand the conceptual origin of the (institutional grammar tool) IGT. This section is largely definitional and introduces revisions to the grammar to ease the validity and reliability of its application. The second part is empirical where we illustrate the use of the grammar with an application of Colorado aquaculture. The conclusion discusses the future applications of the IGT, which can be applied within IAD-guided research as well as research guided by other frameworks and theories seeking understanding and explanations as to how the components of policy designs evolve over time, compare across designs, or shape and are shaped by policy processes.

IAD Framework and the Institutional Grammar Tool

The IAD framework has two main features of interest: a) it views collective action situations as composed of the same set of elements or working parts, where b) multiple action situations exist at any one level of analysis and at various nested levels. The structure of opportunities and constraints available to actors engaged in action situations at one level are assumed to be a product of interactions between actors in situations at higher and lower levels (Ostrom, 2005, 58). The IAD explicitly recognizes three functional levels of analysis: the constitutional level, the collective-choice level, and the operational level. Clearly, the actual

number of levels relevant to each setting will vary. But functionally the IAD identifies the operational level, as where the day-to-day interactions take place among agents and the prescriptions they develop to affect such interactions and their outcomes. At the collective-choice level, we observe the interactions and prescriptions that affect operational activities and at the constitutional level the focus is on those prescriptions that in turn affect rules, norms or strategies governing collective-choice arenas (Ostrom 2005, 58).

An action situation is the social space where "participants with diverse preferences interact, exchange goods and services, solve problems, dominate one another, or fight" (among the many things that individuals can do in such domains) (Ostrom 2005, 14).[1] The outputs of action situations[2] that result in prescriptions to organize repeated interactions are defined as institutions (Ostrom et al. 1994, 28). Such prescriptions can be in the form of new rules, norms, and strategies, to govern their future interactions. Thus[3], rules are the "shared prescriptions (must, must not, may) that are mutually understood and predictably enforced in particular situations by agents responsible for monitoring conduct and for imposing sanctions" (Ostrom, 2007, 23). Norms are the "shared prescriptions that tend to be enforced by the participants themselves through internally and externally imposed costs and inducements" (Ostrom, 2007, 23). Strategies represent the "regularized plans that individuals make within the structure of

[1] The social space itself is conceptualized as an action situation, and the action situation together with participants constitute an action arena. For the purposes of this paper it suffices to only use the term action situation. For a more detailed description and nuanced conceptualization of each term—as well as the IAD as a whole—see Ostrom (2005).

[2] All action situations are conformed by the same clusters of variables, and thus what results from the immense number of ways the clusters of variables combine with each other is the large variety of action situations that we observe in the world everyday. Describing the different working parts of an action situation is beyond the scope of this paper. Please refer to Ostrom (2005) to a detailed description of each of them.

[3] We make this remark because under the IAD tradition, there is a clear conceptual distinction between frameworks, theories and models (Ostrom 2007, 25). But also because in contrast to the definition of rules, norms and strategies provided here, the one provided under the grammar of institutions is much narrower in scope to fit the micro institutional scale under which the grammar operates.

incentives produced by rules, norms, and expectations of the likely behavior of others in a situation affected by relevant physical and material conditions" (Ostrom, 2007, 23).

The IAD is a framework designed to guide inquiry particularly into the interdependencies of institutions and collective action situations. While the IAD framework supports multiple theories and models, the framework also supports multiple tools for data collection and analysis. One of these tools is the institutional grammar described by Ostrom and Crawford (1995; 2005). The purpose of the IGT is to unravel the minute components – analogous to genetic codes in living cells – of formal institutions, such as policies, laws, legislation, and regulations. As an IAD tool, the institutional grammar shares much of the IAD logic but also offers refined definitions for systematically dissecting institutional statements in policy designs.

For the institutional grammar tool, data are collected on "institutional statements," which are defined as "the shared linguistic constraint or opportunity that prescribes, permits, or advises actions or outcomes for actors (both individual and corporate). Institutional statements are spoken, written, or tacitly understood in a form intelligible to actors in an empirical setting." In the initial version of the institutional grammar tool, institutional statements were composed of five working parts: The Attribute (A), Deontic (D), aIm (I), Condition (C), and the Or else (O) (Crawford and Ostrom, 1995, 584).

From these five working parts, institutional statements could then be identified as strategies, norms, and rules. A strategy contains an Attribute, an AIm, and a Condition (AIC), a norm contains, in addition, a Deontic (ADIC), and with the addition of a sanction, or an Or else, the statement becomes a rule (ADICO). Crawford and Ostrom (1995) articulate this distinction between strategies, norms, and rules within the description of the IGT to conceptually mirror the distinction applied in the IAD framework more broadly. They argued that such clear

categorization of the basic elements that constitute policies is necessary for sound policy analysis, and proposed that the grammar can aid analyst in the identification of (i) actions that are required, permitted, and forbidden, (ii) the actors assigned to particular activities, (iii) the temporal and spatial boundaries in which these activities take place, and, in some cases, (iv) the punitive measures associated with non-compliance.

However, the language associated with strategies, norms, and rules distinction within the application of the IGT raises issues of concern as all legislative prescriptions may be viewed as rules. That is, all legislative prescriptions are assumed to be enforceable by some agents within the policy process. As such, this categorization is not applied herein. Instead the authors categorize and refer to institutional statements in terms of the grammar components present within them. An analysis that assesses the theoretical and practical utility of this conceptual distinction when applying the IGT is an area in which more research must be conducted.

The next section provides a brief definition of each of the grammar components based on the original work of Crawford and Ostrom (1995) and later by Basurto et al. (2009). Table 1 provides a summary of characteristics for each of the grammar components as well as examples from coded policies.

Insert Table 1. Summarizing Attribute Characteristics

Attribute

The Attribute is the animate agent (e.g. individual, groups of individuals, or organization(s), that carries out the aIm. If the agent includes individuals then the Attribute might include descriptions, such as age, sex, or position (Crawford and Ostrom 2005, 141). For organizations, the Attribute might include organizational descriptions, such as organizational size (ibid). The Attribute can be implicit or explicit in any given institutional statement (Basurto et

al. 2009). For implicit attributes it is critical that the coder understand the context of the statement within the document so as to ensure that an appropriate implication is made. Further, a coder may encounter an instance in which agents are nested within larger organizations/groups, but only the former, the primary agent, is explicitly stated and the secondary agent may be inferred. For example, such an occasion is observed when an actor is a representative or employee of an organization and he/she is carrying out an action on behalf of his/her organization as a whole. In this case, it might be useful for the coder to know both the nested agent in addition to the secondary agent.

The best way to locate the Attribute of the statement is to identify the actor or organization which is expected to carry out the aIm, or goal or action of the statement (Crawford and Ostrom 2005, 139). In many cases, the Attribute is most clearly identifiable once one has identified the aIm of the statement. By first identifying the aIm, the coder can ensure that there is a logical relationship between the Attribute and the action being described in the aIm, that is, it is possible for the former to perform the latter.

Deontic

The Deontic is the prescriptive operator of an institutional statement that describes what ideally is permitted, obliged, or forbidden (Crawford and Ostrom 2005, 141-149). The Deontic need not always be literally written as the words "permitted", "obliged", or "forbidden" but may also be presented in other forms, such as may, may not, must, should, must not, should not (ibid). Crawford and Ostrom (2005, 144) stated that Deontics must be explicit. However, Basurto et al. (2009) found that while the Deontic is usually explicitly stated, it may also be implicit. The current paper follows Basurto et al.'s (2009) modification in that Deontics are allowed to be implicit because some statements prescribe a command without using the words may, must, or

must not. For example, the verb "required" suggests a "must" Deontic. There are also cases in which an activity is said to be "prohibited" in legislation, the implication for which would be that this activity "must not" occur. Additionally, a Deontic may be carried over, and hence implied, from a preceding institutional statement. Deontic operators can vary by prescriptive force, for example "must" represents more force than "should" (Crawford and Ostrom 2005, 142-149). Deontics serve as useful markers for delineating institutional statements. Coders can start separating institutional statements by looking for a Deontic and then proceeding in the following coding order: [Deontic] [aIm] [oBject] [Condition] [Or Else]/[Attribute].

aIm

The aIm describes the goal or action of the statement that the Deontic refers to (Crawford and Ostrom 2005, 140). The aIm typically consists of all non-deontic verbs in the statement. Any qualifiers of the aIm, including the identification of temporal and spatial boundaries relating to the action being discussed, should be included under the Condition. The interpretation of the aIm will determine the Attribute and the oBject of the statement. Additionally, the aIm may also potentially modify the Deontic. This is particularly applicable in cases where the definition of the aIm is inherently vague or when the aIm has multiple definitions and thus there is ambiguity about the meaning as applicable to the statement.

Condition

The Condition represents the part of the statement that modifies the aIm, often in temporal or spatial terms, but can also include descriptions of how the action identified in the aIm is to occur. As such, the condition can be thought of with the operators "when," "where," and "how" the aIm is allowed, required, or forbidden (Crawford and Ostrom 2005, 149). In other words, Conditions set the prerequisites or restrictions on the aIm. It is assumed that Conditions

can be explicit or implicit (Basurto et al. 2009). When an institutional statement does not specify an explicit Condition nor refer to one implicitly elsewhere, the default value is "at all times" (Crawford and Ostrom 2005, 149). An institutional statement may contain multiple conditions, so long as they do not comprise statements of their own.

Or else

The Or else operator is the punitive action if the rule is not adhered. As was done by Basurto et al. (2009), the guidelines for coding Or else operators have been relaxed compared to the general tenets of the original grammar. For example, it is not required that the Or else operator be backed by another institutional statement for enforcement or the incentives of the monitors (Crawford and Ostrom 2005, 150). The rationale is pragmatic because each institutional statement is coded as an individual unit of observation. The Or else must be explicitly stated in order to be coded.

The Introduction of the oBject

Among the more important challenges identified by Basurto et al. (2009) for applying the Grammar are (i) uncertainty in identifying the Attribute in the institutional statement; (ii) ambiguity regarding how to code statements where the Deontic is implicit rather than explicit, and; (iii) difficulty in distinguishing between the aIm and the Conditions. We propose that some of these challenges can be ameliorated by the addition of one more syntactic element to the grammar: The oBject, which we describe in this section.

The oBject can be defined as the inanimate or animate part of a statement that is the receiver of the action described in the aIm and executed by the agent in the Attribute. For example, "The student wrote the paper." The oBject in this statement would be the paper which was written (aIm) by the student (Attribute). The oBject is often equivalent with the direct

object of the sentence, but not in all cases.

The oBject code helps avoid ambiguity when interpreting institutional statements when there is no explicit Attribute because it helps distinguish the actor (Attribute) from what the actor is acting upon (oBject). For example, Table 2 provides a baseline case where there is a clear agent (the student) charged with carrying out an aIm (write) on a particular oBject (paper). The second example is more challenging to code because the Attribute is implicit and the oBject takes the position of the subject of the sentence. Without the oBject the coding would be the same for both statements, however, with its' addition, potential disagreements among coders on example two would more likely be avoided. The "paper" in these examples would be the oBject because it is the element of the statement to which the Attribute and aIm apply. The clearest cases are when the Attribute is the subject of a sentence and the oBject is the direct object; when the sentence is passive, however, the oBject may be mistakenly coded as the Attribute. Including the oBject as part of the syntax reduces the ambiguity and potential for mistakes by clarifying that the receiver of the aIm is the oBject and the performer of the aIm is the Attribute. Table 2 illustrates the oBject along with the other grammar components.

Insert Table 2. Basic Illustration of the oBject Application

The oBject code is also useful when there are two animate actors in the statement upon which the question arises – which one is the Attribute? In the second two examples in Table 2, there are two explicitly stated animate actors (student and professor) and there may be some ambiguity as to which of the two is the Attribute and which is the oBject. It is desirable to have both actors coded as individual components when conducting configuration analyses. For example, one may be curious to know how many times a particular actor appears in the document and the context in which he/she is discussed, e.g. his/her role in the action situation,

the mandated, allowed, and forbidden activities relating to the role, etc. Thus, the oBject is useful as it allows the coder to list one of the explicitly stated actors as the Attribute and creates a new coding category in which to place the second actor.

Examples three and four in Table 2 reflect the types of cases that may be encountered by coders in which there are two animate actors. Useful strategies for coding such statements associated with using the oBject are to remember, again, that that the Attribute of the statement is he/she who is expected to perform the aIm, and the oBject is the receiver of the aIm. As such, while one example is written actively and the other passively, in both cases, the student (Attribute) is to contact (aIm) the professor (oBject).

Including the oBject component additionally departs from the current Grammar coding format by separating the aIm (action of the statement) from the oBject (receiver of the aIm). Here we have limited the contents of the aIm to only include the primary action, or verb, being addressed in a particular statement. The advantage of taking this approach allows for the aIm to serve as an anchor for the statement, around which all other syntactic components can be identified. For example, once one knows the action that is being discussed, he/she can systematically identify who is responsible for carrying out the aIm, who or what is the receiver of the aIm, under what conditions the aIm should be performed, and the punitive sanctions associated with not performing the aIm as prescribed in the directive.

Summarizing the Utility of oBject

Given the previous discussion, it can be argued that the oBject is useful for the following reasons. First, the introduction of the oBject minimizes coding ambiguity when dealing with statements which lack explicitly stated animate Attributes and provides guidance to coders dealing with statements with apparently multiple Attributes as to which is the appropriate

Attribute of the statement and which the oBject. Thus, by minimizing coding ambiguity, the oBject code enhances the potential for inter-coder reliability. The professor-student examples in Table 2 are illustrative of this point. Second, coding the oBject as distinct from the aIm offers a clear way to delineate all other [A] [B] [D] [C] [O] components of the statement. Third, the inclusion of the oBject is also useful in the data analysis process, particularly when conducting analyses where organizing statements by syntactic component is of interest to the analyst. The utility of the oBject in this sense allows the coder more possibilities in conducting analyses where statement components are more clearly differentiated. It is more likely that the coder would choose to organize analyses and conclusions along the oBject, when considering that, in most cases, the oBject is synonymous with the direct object of the sentence and thus an integral element of the statement.

Coding Guidelines

The following general coding guidelines are a refinement of those developed by Basurto et al. (2009) to code institutional statements. Our modifications are based on the experience of coders in applying the oBject. The general purpose of these guidelines is to offer scholars using this tool a way to reliably parcel institutional statements, a useful task to understand thoroughly and systematically the content of policies and identify theoretically and practically useful relationships between the elements presented within them (Speer 2008), or to develop computational models where agents have the capability to endogenously create or react to different rules (Smajgl et al. 2008).

(1) Identify all definitions, titles, preambles, and headings and disregard them for coding purposes. Titles and headings are first discarded because they are fairly easy to locate and rarely constitute an institutional statement of theoretical or practical interest.

(2) Identify sections and subsections of the bill as initial units of observation. We call headers of sections and subsections as "outline indicators." Outline indicators are titles, subheadings, a capital or lowercase letters, colons, semicolons, or Roman numerals, used to separate sections from subsections and subsections from sub-subsections, etc. These initial units of observation are temporary and may be divided into additional units.

(3) Subdivide all initial section or subsection units from step 2 that have multiple sentences into sentence-based units of observation. If a section or subsection does not have a complete sentence ending in a period, code the entire section or subsection as one unit of observation. If there are multiple sentences in the section or subsection, code each sentence as units of observation.

(4) Code the units of observation following the ABDICO syntax. The text in each unit is coded with respect to the Attribute, oBject, Deontic, aIm, Condition, and Or else. You may have more than one Attribute or aIm in the same statement. For example, if you have more than one Attribute for which all other syntactic components are identical, multiple Attributes may be included in the same statement.

Example: "A permittee or operator shall give an invoice to the person receiving viable fish or gametes at the time of transfer of possession."

Additionally, if you have more than one aIm for which all other syntactic components are identical then multiple aIms may be included in one statement.

Example: "The Fish Health Board shall review or initiate and consider every rule which relates to fish health." (Fish Health Board Rules)

If, however, you have more than one aIm and more than one Attribute or oBject, then the statement should be broken up so that each Attribute is distinctly assigned to each of the aIms being discussed.

Example: “The Fish Health Board shall exercise its powers (Statement 1) and perform its duties (Statement 2)…” (Fish Health Board Rules)

Further, if you have two aIms for the same Attribute or oBject but there are multiple conditions that comprise multiple institutional statements, then the statements should be broken up based on the aIm and relevant Conditions.

Example: “Facility owners shall annually complete and submit a permit renewal application and all submissions shall be mailed by December 31st.

Statement 1: Facility owners (A) shall (D) annually (C) complete (I1) and submit (I2) a permit renewal application (B).

Statement 2: All submissions (B) shall (D) be mailed (I) [facility owners (A)] by December 31st (C).

(5) Code statements according to components present. In our exercise, we separated statements into AIC/ABIC, ADIC/ABDIC, and ADICO/ABDICO categories.

(6) When applicable, imply components when they are not explicitly provided in the statement. In some cases, the Attribute is missing because the statement under consideration is actually an extension of the statement prior to it in the document. In this case, the coder should use the Attribute from the previous statement. In other cases, an Attribute will not be obvious, and thus an implication should be made by identifying the logical actor associated with performing the specified aIm. Sometimes in legislative documents, the agent who is requiring that the action being discussed in the statement be carried out may be the Attribute. In some cases the Deontic can also be implicitly stated, as when some statements prescribe a command without using the words may, must or must not. For the Condition component, unless stated otherwise in preceding statements, the default Condition will be "at all times," meaning that the directive is applicable in all cases unless an exception is explicitly stated.

(7) Multiple coders for inter-coder reliability. As with all coding applications, each document should be coded by multiple coders to ensure that data collected through the coding process is done so reliably across all coders. Coding methods should be iteratively revised until a desirable agreement percentage is met. Inter-subjective reliability should be discussed communally among the team of coders as each team will encounter difficult cases unique to the type(s) of document(s) being coded.

Case Study: Colorado State Aquaculture

We illustrate the operationalization of the grammar of institutions and its potential for policy analysis through an empirical application to all of the major laws that guide aquaculture activities in Colorado State. Aquaculture is defined as, "the farming of organisms that live in

water, such as fish, shellfish, and algae (USGS, 1996)." Aquaculture is a relevant national and state-level policy analysis issue given that it is one of the fastest growing food commodities (Naylor et al., 2001), and its governance is embedded in a complex regulatory framework.

The decrease of fish stocks in capture fisheries has served as a primary impetus to grow the U.S. aquaculture industry to meet increasing consumer demand (Boyd, 2003). Regulatory concerns relating to aquaculture include water pollution from farm effluent, competitive feed pricing, and silting issues in federal and state waters (Ackefors et al., 1994). The regulation of aquaculture activities occurs at multiple levels—local, state, regional, and federal—and is conducted by a number of different agencies at each geographic scale (McDaniels et al., 2006, 426). The decentralization of regulatory responsibilities has meant that different stakeholders with varying objectives are involved at each level to decide how and when the aquaculture industry is regulated.

In the early 1990's the Colorado aquaculture industry formally requested to be incorporated into the jurisdiction of the Colorado Department of Agriculture, thus conferring the rights and responsibilities associated with other types of agricultural activities in the State upon it. A new set of laws and regulations were created to address this jurisdictional change. This study seeks to understand some of these rules and regulations by systematically coding the institutions presented within them.

The two primary agencies charged with the regulation of aquaculture in Colorado State are the Colorado Department of Agriculture (CDoA) and the Colorado Division of Wildlife (CDoW). The CDoA is responsible for permitting procedures relating to aquaculture and has two complementary legislative documents: the Colorado Aquaculture Act (CAA) Statue and the Rules Pertaining to the Administration and Enforcement of the Colorado Aquaculture Act, that

detail the structure and responsibilities of the Aquaculture Board, procedural directives regarding destruction orders and all other permits and regulations present within the legislation, and the fee structure assigned to different permit types.

The CDoW deals with matters of fish health and has two legislative documents that deal directly with aquaculture. The first (Article VII of the Chapter 00 – General Provisions) specifies prescribed fish health testing, responsibilities of the State Fish Health Pathologist, and disinfection and quarantine procedures. The second (Section 33-5.5-101 of Title 33 of the Wildlife and Parks and Regulations Rules) outlines the responsibilities of the Fish Health Board as they pertain to aquaculture.

Taken together there are four legislative documents governing aquaculture activities in Colorado: the Colorado Aquaculture Act (i.e. CAA Statue), the CAA Administration and Enforcement Rules (i.e. Rules Pertaining to the Administration and Enforcement of the Colorado Aquaculture Act), Article VII of the Chapter 00 Regulations (herein Chapter 0), and the Fish Health Board Statute (Section 33-5.5-101 of Title 33). We coded each of these in their entirety for our analysis.

Results

Inter-coder Reliability

One of the major challenges found by Basurto et al. (2009) in operationalizing the grammar was to identify reliably Attributes and Conditions from other syntactic components. To assess the effectiveness of our coding guidelines and whether the addition of a new syntactic component—the oBject—contributed to address this challenge we conducted a test of inter-coder reliability on three different pieces of legislation. First, we coded 35 statements from the Colorado Aquaculture Act Administration and Enforcement Rules, constituting approximately

10% of the total statements coded across all four documents. The results from this test are included in Table 3 and show at least 80 percent agreement was found between coders for all components. Next, we coded 10 statements from the transportation and abortion legislation coded in Basurto et al. (2009), five for each and constituting 50% of the total statements previously coded by them, to determine if the addition of the oBject code contributed to a higher rate of agreement between coders across statement components. Special attention was given to observing a higher agreement rate on Attributes and Conditions. The results from this test are also included in Table 3 and show that, indeed, though not entirely resolving the issues, the inclusion of the oBject code increased inter-coder reliability for both fields.

Table 3 shows a reduction in ambiguity in the coding of all syntactic components of the grammar.

Insert Table 3. Comparison of Inter-Coder Reliability Test Results

While the inter-coder reliability rates were comparably higher than those obtained by Basurto et al., (2009), our results still show most disagreement when coding Attributes, Conditions and the oBject. Disagreements took place when coders failed to parse similar institutional statements and when coders failed to carefully assess whether certain words constituted descriptors of the oBject (in which case they would be included in the oBject field) or modifiers of the aIm (in which case they would need to be included in the Condition field). We acknowledge that there is always going to be some disagreement between coders due to the inherent vagueness of language. However, we find that most coding disagreements can be prevented when the coder is well acquainted with the context of the bill and the coder is able to carefully determine the aIm and from it: who carries out the aIm? (i.e. the Attribute), who or

what is the receiver of the action described in the aIm? (i.e. the oBject) and how, when, where, or if the aIm is modified? (i.e. the Condition).[4]

Descriptive Results

First, we conducted a basic frequency count for all four policy documents to determine the total number of statements within each document and categorize them by components present. Table 4 shows the results of the initial descriptive analysis.

Insert Table 4. Summarizing Institutional Statements

Descriptive information such as the displayed in Table 4 is useful to identify potentially interesting trends and tendencies in the data. In our case, for instance, it draws attention to the fact that in comparison with all other pieces of legislation, the CAA Administration and Enforcement Rules contain a proportionally high number of institutional statements containing only Attributes, Aims, and Conditions, (30%), that is, statements without a Deontic (the prescriptive operator that describes what ideally is permitted, obliged, or forbidden) and Or else (the punitive sanction associated with non-compliance with the policy directive). For example, "Amendments to these rules are proposed for adoption by the Commissioner of the Colorado Department of Agriculture." (CAA Rules) This finding might warrant further inquiry for the analyst about the particulars of the institutional statements that conform it. Among others, a potentially interesting question for the analyst to pursue might be: What are the reasons an

[4] It is our position that it will be up to individual teams of coders to clarify coding guidelines regarding each of the statement components to suit their coding needs and objectives to achieve a suitable agreement percentage for their purposes. Our primary objective in conducting an inter-coder reliability test was to ensure that our data was collected based upon reliable methods and guidelines. Data collection was completed in accordance with coding rules and strategies previously articulated by the other scholars and further developed based upon our own coding experiences (Crawford and Ostrom, 1995; Basurto et al, 2009). The selection of coding criteria is not meant to express normative evaluations and/or biases of the data by the authors. Such normative considerations arise in the interpretation of the data and reflect the epistemological biases of the researchers.

agency devoted to administration contains relatively few guidelines describing what is permitted, obliged or forbidden?

Further, Table 4 indicates that there is only one institutional statement containing all Grammar components in the sample of policy documents (CAA Statute). This finding is consistent with Basurto et al.'s (2009). However, when applying the grammar to the study of legislation the lack of Or else in a statement does not suffice to conclude that no punitive measures are associated with non-compliance. Given the nested quality of legislation, higher level governmental and/or agency level policies likely discuss the punitive measures that are to be taken against those who fail to comply with policy directives.

Next, for the four policy documents we also conducted a frequency count to determine the three Attributes, oBjects, and Deontics most frequently occurring within each. Conditions were not included within this analysis because this field contained a lot of information that varied significantly between statements. Thus information within this field was not amenable to systematic compartmentalization. Or elses were not included due to the rarity of their occurrence in the legislation coded. A frequency count of aIms was conducted, but due to the high amount of variability between statements, the results are not presented here. Table 4 also provides a summary of these descriptive analyses of Attributes, oBjects, and Deontics.

A preliminary overview of Table 4 allows one to begin to compare and contrast the scope of the four policies. With regard to policy actors, the Colorado Aquaculture Act, for example, depicts actors such as the Colorado Aquaculture Board and the Commissioner of Agriculture as having primary regulatory and implementation authority. As these two documents originate from the same agency, the Colorado Administration and Enforcement Rules were also likely to include the Colorado Department of Agriculture but additionally include aquaculture facility

owners and operators. A basic comparison of Attributes thus highlights the primary actors involved in the implementation process and hints at the relative authority that actors have in making decisions that shape aquaculture action situations. Also observable in Table 4 is insight into the intent of the actions shaped by the legislation through the modal oBjects. oBjects illuminate the focal points of regulatory processes and procedures that policy actors are associated with.

Where many oBjects are prescribed to single actors, an implication may be made that his/her scope of activities constitute a wide range, thus signaling more involvement in the aquaculture arena. The converse may also be implied. For example, the oBjects related to the Commission of Agriculture relate primarily to dealing with aquaculture rules and permit requirements, thus implying that this actor's scope of activities involves a higher level management of aquaculture related issues limited to a few specific areas. This contrasts with facility owners and operators who are associated with wide range of oBjects from fish health testing, to administrative procedures, to facility management techniques. This comparison is assumed to be a generally accurate representation regarding the involvement of modal actors in the aquaculture industry, for while the aquaculture constitutes only one of the agricultural areas with which the Commissioner deals, aquaculture for a facility owner likely is his/her primary daily activity.

In summarizing the modal Attributes, oBjects, and Deontics within each of policy documents in this manner, one may begin to discern how individual components from institutional statements cumulatively structure action situations described within policies (Ostrom, 2005, 175). Within each policy document one may observe who are the primary participants, and various characteristics regarding them, including, for example, the activities

associated with them and the control that their respective positions afford. The data may then be used to derive empirically testable questions. Examples of questions include: To what extent do Deontics signal the discretionary authority of modal actors? How do Attributes and oBjects relate to one another and what do these relationships imply about the scope of authority and/or responsibility of modal Attributes? Because the information gleaned from such tables is limited, however, one should conduct additional types of configuration analyses to uncover additionally meaningful trends and tendencies.

Configuration Analysis

Insert Figure 1. Configuration Analysis

To illustrate the analytic potential of the institutional grammar Figure 1 shows (1) how political actors and organizations are linked across levels analysis around shared processes (Kiser and Ostrom, 2000); and (2) maps these processes, through the identification and configuration of components, in order to understand how they are intended to guide the behavior of actors through outlining "strategic options and role expectations" (Kiser and Ostrom, 2000,6). As a result the analyst may observe a) how different coded components are linked to animate a particular Attribute's behavior regarding a prescribed political process; b) how Attributes themselves are linked in relation to policy directed processes, in terms of both their individual and organizational interactions; and c) what are the policy procedures associated with modal Attributes in relation to levels of analysis? A discussion of each of these in relation to Figure 1 is provided below.

a) Mapping how different components of the institutional grammar structure opportunities and constraints to different policy actors (i.e., Attributes).

In order to determine how policy related actors are expected to act, one must first know who the primary actors are whose behavior policies are intended to shape. In Figure 1, the modal

Attribute from each of the legislation examined is represented in the left hand column. The Commissioner of Agriculture is from the Colorado Aquaculture Act Statute (CDoA), the Colorado Department of Agriculture is from the Colorado Aquaculture Act Administration and Enforcement Rules (CDoA), the Fish Health Board is from the Fish Health Board Rules (CDoW), and Facility Owners and/or Operators are from the Chapter 0 Regulations (CDoW). Each of these Attributes is discussed in relation to the oBject most frequently occurring across the two Attributes in the two legislative documents for each of the respective agencies. For instance the oBject "Aquaculture Permits" is implemented by two different actors or Attributes: the Colorado Department of Agriculture and the Commissioner of Agriculture. These Attributes determine the total possible aIms that must, must not, or may be performed in relation to the oBject. Following this example, on the one hand, the Colorado Department of Agriculture must not deny an aquaculture permit for local and non-threatening species, but may also deny or limit an application for an aquaculture permit or its renewal, or must expire facility permits on December 31st or each year, to name just three of seven different institutional arrangements that the Colorado Department of Agriculture is capable of as related to aquaculture permits. On the other hand, the Commissioner of Agriculture can also issue directives related to the same object, "aquaculture permits" i.e., may withhold, deny, or revoke aquaculture permits, or must provide for the issuance of permits or must establish permit fees. Note that it is through this mapping that one can understand how statement components relate to one another in structuring the opportunities, constraints, apparent contradictions and potential for conflict among modal actors vis-à-vis policy directives.

b) Uncovering institutional diversity

By anchoring Attributes and aIms around a shared oBject as done in Figure 1, we demonstrate how one oBject may formally appear in a variety of action situations as prescribed by the various policies and involving multiple actors, organizations, and processes; that is, the various opportunities and constraints available to actors via prescribed processes and related prescriptive operators in relation to a particular oBject. Such a depiction segues to a host of analytical possibilities. For example, one can explore the networks of actors associated with an oBject. Additionally, one may also consider how these actors' individual and organizational affiliations shape how they interact with the relevant oBject.

For example, in the bottom half of Figure 1, the oBject depicted is "Quarantine Orders." The two actors portrayed in relation to quarantine orders are the Fish Health Board, the members of which are formally opportuned with "Approving destruction and quarantine orders," and Facility Owners and/or Operator who complementarily "Have the right to appeal all disinfection and quarantine orders." Not only does this demonstrate the opportunities available to each of the actors relating to a shared oBject, but the ways in which they may interact in an action situation concerning quarantine orders.

c) Linking Attributes through different levels of analysis

Mapping legislation as in Figure 1 might be theoretically useful to an analyst interested in determining actors' constraints and opportunities at different levels of analysis. As Kiser and Ostrom (2000) write: "At each level individual and collective choice is constrained to some range of strategic options. The point of this demarcation of levels is to highlight some fundamental similarities among political processes at different levels of analysis. At each level actors confront an action situation with strategic options and role expectations as defined at

higher levels, and the choice of actors at one level jointly produce patterns of interactions and outcomes." (Kiser and Ostrom, 2000, 6).

The level of analysis at which the Attributes' prescribed responsibilities are understood to occur is shown to the right hand side of the configuration analysis for each actor, and is displayed as either being the "Collective Choice Level" or "Operational Choice Level." The decision regarding which level to place the respective Attributes at is determined by observing the types of aIms associated with each actor. This discussion is not to imply that actors only act at one level of decision making, but rather to showcase how their roles and responsibilities at different levels are formalized within policy designs. For example, most of the tasks associated with the Colorado Department of Agriculture and the Commissioner of Agriculture represent activities that would shape the structure of activities dealing with aquaculture permits at an operational level; the former assigned such duties as "issuing permits" and "applying the most restrictive state/federal for permitting," and the latter with "establishing permit fees" and "providing for the issuance of permits." Since these activities can be understood to shape rules that structure activities at the operational level, each of these Attributes are assumed to work primarily at a collective choice level. Similarly the Fish Health Board is also charged with tasks associated with the collective choice level such as "approving all destruction and quarantine orders" and "reviewing destruction or quarantine regulations." Conversely, facility owners are evidently not in a position to determine the structure of administering quarantine orders, however they do "have the right to appeal" them. As such, it is determined that facility owners affect quarantine orders within action situations at the operation level.

Conclusion

The application of the IGT provided herein illustrates a systematic approach to identifying the basic elements of a policy design and features a configuration analysis to demonstrate how minute elements of policies may be aggregated and configured to uncover useful practical and theoretical relationships. From the analysis of each policy document, we gained insight into the various ways that these policies seek to structure the activities of aquaculture participants in Colorado State. A next step is to arrange coded information in terms of specific types of action situation variables that statements are meant to affect. That is, how statements articulate the comparable positions of these participants, how individuals arrive at these positions, and what they may or may not do once they are there.

This paper contributes to the emerging study of the application of Crawford and Ostrom's institutional grammar by introducing the oBject. The oBject is incorporated into the institutional grammar and coding guidelines are clarified to address challenges posed by Basurto et al. (2009). The first of these challenges deals with conceptually defining the Attribute. In past applications the Attribute was defined as "to whom or what the institutional applies." With the inclusion of the oBject a clear distinction is made regarding who is expected to carry out the aIm (Attribute) and who or what is expected to receive the aIm (oBject). In addition, by limiting the definition of the aIm to only include the non-Deontic verb of the statement, ambiguity concerning the distinction between the aIm and the Condition is reduced. In the revised definition, one or few verbs should be included in the aIm, and all modifiers should be included in the Condition field.

The configuration analysis (Figure 1) facilitates a discussion of the ways in which such analyses may uncover theoretical relationships of interest. While the analysis was guided by the IAD framework, scholars need not restrict the application of the IGT to the theoretical logic of the IAD. The institutional grammar offers a methodological tool for collecting data to

systematically understand the content of policy design. The theoretical analysis and interpretation of the data may be informed by a wide variety of policy process models, theories, and/or frameworks. For example, scholars applying the social construction framework may find it most useful to configure the coded data around sanctions, or Or else components, in relation to different actors presented in the policy document to understand how benefits and burdens are formalized across different policies (Schneider and Ingram, 1997). Further, data could be configured to support the application of agent based models that seek to understand how policies shape actors' individual and aggregated decision making behaviors (Janssen, 2005; Smajgl et al. 2008). The advocacy coalition framework predicts that policies are but the translation of beliefs; thus, this grammar provides a means for linking coalition beliefs to institutions (Sabatier and Jenkins-Smith, 1993). Moreover, the IGT could aid any theory of policy change to understand how institutions evolve over time. In IAD guided research, the IGT could be used to assess the extent of congruence between rules-in-form and rules-in-use thereby providing insight into effective monitoring and enforcement as well as effective implementation.

For those who do wish to study coded data from the perspective of the IAD framework, however, future research using the IGT should elaborate upon theoretical issues that we address in our analysis. Namely, this involves exploring the two analytical approaches we proffer to develop theoretically motivated questions. To reiterate, these two approaches, include: (1) mapping political processes or procedures associated with modal Attributes in relation to levels of analysis; and (2) demonstrating how different coded components are linked to animate a particular Attribute's behavior regarding a prescribed political process. Additionally, future research could consider supplementing legislative coding with other forms of data collection methods such as interviews or a questionnaire to test empirical questions derived from

relationships identified in coded data; for example, interviewing policy relevant actors in the action situations to understand how they are interpreting policy directives and, further, which statement components are most influential in shaping their interpretation.

Understanding the content and interactions of policy designs has puzzled researchers for decades. The challenge is that policy designs are composed of elements traced from prior politics with nontrivial interdependencies resulting in outputs and outcomes; that is, policy designs can be thought of as complex systems (Simon, 1996). In complex systems, boundaries and scales are artificial, requiring both simplifying assumptions and cross-scale theorizing. The initial move in studying complex systems is to identify and define the elementary elements of the system both reliably and validly, for faulty description precludes explanation. The next move is to configure those elements to present a simplified depiction of the system and then to answer research questions, to test hypotheses, or both. While not attempted in this paper, the end goal is to link the elements and the configuration of elements to a broader system of actors, physical and material conditions, community characteristics, and, especially, the political processes that created the policy design and the political processes that proceed from the policy design.

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Table 1. Summarizing Institutional Grammar Characteristics

1. Attribute Characteristic and Example from Coded Legislation	
• Must be an animate actor	"A qualified fish health pathologist shall inspect all facilities annually."
• May be explicit or implicit	"Fish health inspections shall be conducted annually [by a qualified fish health pathologist]*."
• Must include all relevant descriptors	"The fish health board shall meet annually."Descriptors = "fish health"
• Attribute must logically be able to perform aIm	"The Commissioner shall enforce all rules and regulations concerning aquaculture except those which relate to fish health."
2. Deontic Characteristic and Example from Coded Legislation	
• The prescriptive operator of an institutional statement that describes what is permitted, obliged, or forbidden	"The Aquaculture Board shall annually select a chairperson."
• Usually explicit, but may also be implicit	"The Board is authorized to recommend rules to the Commissioner." Implied Deontic = may
3. aIm Characteristic and Example from Coded Legislation	
• Describes the goal or action of the statement, i.e. usually the verb of the statement.	"Director of the Division may approve destruction orders."
• Any qualifiers of the aIm, including the identification of temporal and spatial boundaries, should be included in the Condition.	"The aquaculture board shall annually select a chairperson and vice chairperson." aIm = "select" Condition = "annually"

* = "[ ]" designate that statement has been implied.

Table 1. Summarizing Institutional Grammar Characteristics (continued)

4. Condition Characteristic and Example from Coded Legislation	
• Includes all qualifiers of the aIm, including when, where, and how the action in the aIm is to be performed	"Applications for exemption shall be submitted to the Director <u>at least 60 days prior to any proposed stocking</u>."
• Default implicit conditions is "at all times"	"All aquaculture facility permits must be certified [<u>at all times</u>]."
• Institutional statements may contain multiple conditions	"Exemptions granted by the Director shall be valid <u>unless the applicant fails to comply with the terms of the exemption</u> or <u>fails to submit an annual report</u>." Condition 1 = "…unless the applicant fails to comply with the terms of the exemption…" Condition 2 = "…fails to submit an annual report…"
5. Or else Characteristic and Example from Coded Legislation	
• The punitive action if the directive is not followed.	"Any person that violates the provisions of this article shall be fined <u>no less than one thousand dollars and no more than five thousand dollars</u>."

* = "[ ]" designate that statement has been implied.

Table 2. Basic Illustration of the oBject Application.

	Statement	Coding
Example One	The student must write paper by date or receive a lower final grade.	A = student B = paper D = must I = write C = by date O = or receive a lower final grade
Example Two	Paper must be written by date or receive a lower final grade.	A = [Implied] student B = paper D = must I = be written C = by date O = or receive a lower final grade
Example Three	Student must contact the professor by date or receive a lower final grade.	A = student B = professor D = must I = contact C = by date O = or receive a lower final grade
Example Four	Professor must be contacted by the student by date or receive a lower final grade.	A = student B = professor D = must I = contact C = by date O = or receive a lower final grade

Table 3. Comparison of Inter-Coder Reliability Test Results

Syntactic Component	Agreement between coders for Colorado aquaculture legislation (%)	Average agreement between coders for transportation and abortion legislation coded with addition of oBject*	Average agreement between coders for transportation and abortion legislation coded in Basurto et al. (2009) (%)
Attribute	86	90	82
oBject	86	80	NA
Deontic	97	90	89
aIm	94	90	92
Condition	80	80	67
Or else	100	100	100

* Two experienced grammar coders participated in this effort. One had participated in the coding of the Colorado aquaculture legislation and the other in the previous coding done in Basurto et al. (2009).

Table 4. Summarizing Institutional Statements

	Colorado Dept of Agriculture		Colorado Dept of Wildlife	
	CAA Statute	CAA Admin & Enforcement	Chapter 0	Fish Health Board Statute
Number of AIC/ABIC Statements	2	16	8	1
Number of ADIC/ABDIC Statements	56	38	185	39
Number of ADICO/ABDICO Statements	1	0	0	0
Total Institutional Statements	59	54	193	40
Modal Attributes (Number of Occurrences in Legislation)	1. Commissioner of Agriculture (16)	1. Colorado Dept. of Agriculture (24)	1. Facility Owners and/or Operators (52)	1. Fish Health Board -- Collective (14)
	2. Aquaculture Board (14)	2. Aquaculture Permittees (13)	2. Qualified Fish Health Pathologist (43)	2. Director of the Division of Wildlife (10)
	3. Colorado General Assembly (7)	3. Facility Owners and/or Operators (6)	3. Possesor of Live Aquatic Wildlife (30)	3. Fish Health Board Members -- Individuals (9)
Model Objects (Number of Occurrences in Legislation)	1. Rules and Regulations (5)	1. Aquaculture Facility Permit (11)	1. Triploid Grass Carp (7)	1. Fish Health Board Members (7)
	2. Aquaculture Facility Permit (4)	2. Purpose of the Propossed Regulations (8)	2. Applications for Exemptions (5)	2. Rules (5)
	3. Suspensions or Revocations of Aquaculture Facility Permits and Powers of the Board (3)	3. Aquaculture Permittee Records (4)	3. Dikes, Diploid Grass Carp, Fish, Fish Health Certification, and Whirling Disease Management Plan (4)	3. Destruction Orders (4)
Deontics (Number of Occurrences in Legislation)	Must (35)	Must (24)	Must (137)	Must (36)
	Must Not (6)	Must Not (9)	Must Not (13)	Must Not (1)
	May (16)	May (4)	May (32)	May (1)
	May Not (0)	May Not (1)	May Not (3)	May Not (0)

Figure 1. Configuration Analysis